"CATALYTIC GASIFICATION OF COAL USING EUTECTIC SALT MIXTURES"

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BIOGRAPHICAL SKETCH

Dr. Yaw D. Yeboah received his doctorate degree in Chemical Engineering from the Massachusetts Institute of Technology (MIT) in June 1979 with specialization on fluidization, coal pyrolysis, and desulfurization. Dr. Yeboah was the first to receive four degrees in four years from MIT. He obtained bachelors degrees in Chemical Engineering, Chemistry, and Management and masters in Chemical Engineering Practice from MIT in June 1975. He is presently Professor of Engineering and Technical Director of the Research Center for Science and Technology at Clark Atlanta University.

His areas of research expertise include combustion, catalysis, scale formation and prediction, hazardous chemicals and waste destruction, bioengineered remediation, and environmental and chemical process modeling. He is the principal investigator (PI) of the DOE-funded project on Catalytic Gasification of Coal Using Eutectic Salt Mixtures being conducted jointly by Clark Atlanta University, the University of Tennessee Space Institute and Georgia Institute of Technology.

ABSTRACT

The specific aims of this study are to identify appropriate eutectic salt mixture catalysts for the gasification of Illinois #6 coal, evaluate various impregnation or catalyst addition methods to improve catalyst dispersion, and evaluate gasification performance in a TGA and a bench-scale fixed bed reactor. The project is being conducted jointly by Clark Atlanta University (CAU), the University of Tennessee Space Institute and Georgia Institute of Technology with Clark Atlanta University as the prime contractor.

Several single salt catalysts and binary and ternary eutectic catalysts were investigated. The results showed better gasification activity in the presence of the catalysts tested. The order of catalytic activity of eight single salt catalyst tested was:

Li2CO3>Cs2CO3>CsNO3>KNO3>K2CO3>K2SO4>Na2CO3>CaSO4

The eutectic salt studies showed clear agreement between the melting points of the prepared eutectics and reported literature values. The order of catalytic activity observed was ternary > binary > single. Physical mixing and incipient wetness method were investigated as catalyst addition techniques. With the soluble single salt catalysts, the incipient wetness method was found to give better results than physical mixing technique. Also, catalyst preparation conditions such as catalyst loading, drying time and temperature were found to influence the gasification rate. Based on the TGA tests, the 43.5%Li2CO3-31.5%Na2CO3-25%K2CO3 ternary eutectic and the 29%Na2CO3-71%K2CO3 and 2.3%KNO3-97.7%K2CO3 binary eutectics were selected and studied in the bench-scale fixed bed reactor.

The eutectic salts were found to be highly insoluble in aqueous medium. As a result, the technique of adding the eutectic to the raw coal was found to be better than using wet methods. Also addition of the catalyst to the raw coal appeared to give better gasification results than addition to pyrolyzed coal. In addition, eutectic catalysts added to the coal yielded better gasification rates than rates obtained by mixing the individual salts in the eutectic ratio with the coal. These results, especially with the eutectic catalysts, are very significant since the use of the low melting eutectics will reduce the severity of gasification processes.